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**SUBSTITUTE SPECIFICATION – MARKED-UP VERSION**

by

**KILIAN SAUERESSIG**

for a

**APPARATUS AND METHOD FOR EMBOSSING WEB-SHAPED MATERIALS**

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Attorney Docket No.: B&B-134

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**DIRECT TRANSLATION OF GERMAN SUBSTITUTE SPECIFICATION -- CLEAN  
VERSION**

**APPLICATION FOR UNITED STATES LETTERS PATENT**

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**APPARATUS AND METHOD FOR EMBOSsing WEB-SHAPED MATERIALS**

**[0001]** This application is a national stage application of International Application No. PCT/DE2004/001920, filed August 31, 2004, which is herein incorporated by reference in its entirety.

**BACKGROUND****Field of the Invention**

**[0002]** The present invention relates generally to embossing. More particularly, embodiments of the present invention relate to an apparatus for cleaning deposits on an embossing roller during an embossing process.

**Background of the Invention**

**[0003]** Embossing is a popular technique for creating three-dimensional designs on or creating textures in substrates, such as web-shaped paper or tissue material. To emboss a substrate, an embossing pattern on an embossing roller rolls over a substrate, for example tissue paper, and the embossing pattern breaks fibers in the paper. During embossing, sediment, such as paper fibers and dust, adhere to gaps within embossing patterns, which seriously contaminate embossing rollers. One solution to this problem is to halt production to allow for cleaning of embossing rollers. Another solution to address this problem includes complex devices that require spraying water or solvent on embossing rollers to wash away sediment. Such solutions are costly or can lead to larger difficulties such as clogging of embossing rollers. Consequently, a need exists for a cost-effective and design-effective device for embossing web-shaped materials that remains clean of sediment during operation.

## **BRIEF SUMMARY OF THE INVENTION**

**[0004]** The present invention is directed toward a roller arrangement for embossing web-shaped materials that allows for cleaning during operation. An embodiment of the present invention provides a roller arrangement for embossing web-shaped materials, such as web-shaped paper and tissue materials, comprising at least one embossing roller and a cleaning roller. An embossing pattern of a plurality of elevations is disposed on the embossing roller. A plurality of cleaning elements is disposed on the cleaning roller. The embossing roller can comprise either a punch or a matrix.

**[0005]** Another embodiment of the present invention includes a punch, a matrix, and a cleaning roller. A first embossing pattern of a plurality of elevations is disposed on the punch. A second embossing pattern of a plurality of elevations is disposed on the matrix. A plurality of cleaning elements is disposed on the cleaning roller. Elevations of punches and matrixes and cleaning elements can be aligned in rows spaced apart in a circumferential direction. Elevations of the first embossing pattern can be arranged such that they can be lowered into free spaces between elevations of the second embossing pattern. Cleaning elements of the cleaning roller can be arranged in such a way to allow interaction with a punch or a matrix. Interaction between cleaning elements and elevations of a punch or a roller can occur in between rows of the elevations. This configuration allows the cleaning elements to remove sediment collecting in between rows of elevations of punches and matrixes.

~~Roller arrangement for embossing web-shaped materials~~

~~The invention discloses a roller arrangement for embossing web-shaped materials, in particular, web-shaped paper and tissue materials comprising a punch on which a first embossing pattern~~

with a plurality of spaced-apart elevations is arranged, and a matrix on which a second embossing pattern with a plurality of spaced-apart elevations is arranged. The elevations on the first embossing pattern can be lowered into free spaces on the second embossing pattern.

[0006] Another embodiment of the present invention provides a method for embossing web-shaped material by running an embossing roller on web-shaped material, where a plurality of elevations are arranged on the embossing roller in rows that are spaced apart in a circumferential direction. A cleaning roller is positioned adjacent to the embossing roller, where a plurality of cleaning elements are aligned on the cleaning roller to fit in between the rows of the embossing roller. The plurality of cleaning elements run in between the rows of the embossing roller to remove sediment.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0007] Figure 1 is a schematic diagram showing an exemplary punch in accordance with a first embodiment of the present invention.

[0008] Figure 2 is a schematic diagram showing an exemplary cleaning roller that can interact with a punch such as that embodied in Figure 1.

[0009] Figure 3 is a schematic diagram showing an exemplary punch in accordance with a second embodiment of the present invention.

[0010] Figure 4 is a schematic diagram showing an exemplary cleaning roller that can interact with a punch such as that embodied in Figure 3.

[0011] Figure 5 is a schematic diagram showing an exemplary path of cleaning elements embodied in Figure 2 between elevations on a punch such as that embodied in Figure

1.

[0012] Figure 6 is a schematic diagram showing an exemplary path of cleaning elements embodied in Figure 4 between elevations on a punch such as that embodied in Figure 3.

[0013] Figure 7 is a schematic diagram showing an exemplary punch in accordance with a third embodiment of the present invention.

[0014] Figure 8 is a schematic diagram showing an exemplary cleaning roller that can interact with a punch such as that embodied in Figure 7.

[0015] Figure 9 is a schematic diagram showing an exemplary path of cleaning elements embodied in Figure 8 between elevations on a punch such as that embodied in Figure 7.

#### **DETAILED DESCRIPTION OF THE INVENTION**

[0016] An embodiment of the present invention provides a roller arrangement for embossing web-shaped materials, such as web-shaped paper and tissue materials, comprising at least two embossing rollers and at least one cleaning roller. An embossing roller can be either a punch or a matrix. A punch includes a first embossing pattern with a plurality of spaced-apart elevations. A matrix includes a second embossing pattern with a plurality of spaced-apart elevations. Elevations on the first embossing pattern can be lowered into free spaces on the second embossing pattern.

[0017] When the first embossing pattern and the second embossing pattern of a punch and matrix are geometrically adjusted on top of each other in such a way that the elevations mutually and substantially correspond at a number of locations, a micro fissure embossing is possible. In other words, the geometry of the embossing pattern breaks the  
The first and second embossing patterns break fibers of the web-shaped

material, thus greatly increasing the water absorbency capability of said the fibers. During the embossing of the web-shaped materials, such as web-shaped paper and tissue materials, sediment such as paper fibers as well as fiber and dust, adhere to the gaps of the within embossing pattern patterns, which can seriously contaminates the punch and matrix. Up until now, production would be interrupted to allow for the cleaning of the roller to achieve good embossing results contaminate punches and matrixes.

[0018]

[0019] It is the object of the present invention to configure a roller arrangement for

[0020] In accordance with an embodiment of the present invention, elevations on an embossing web-shaped material pattern of a punch or matrix are arranged in rows that are spaced apart in a circumferential direction. Elevations on an embossing pattern can also be arranged in such a way that cleaning can occur during operation. a checker board pattern. For example, elevations could, when seen from a top view, be cross-, square-, oval-shaped or shaped in other similar configurations, as long as a desired micro-fissure embossing is achieved as a punch and matrix interact.

[0021] This object is achieved with a roller arrangement in In accordance with claim 1. In accordance with with an embodiment of the present invention, the elevations on the embossing pattern of the punch or matrix is arranged in rows that are spaced apart in the circumferential direction while at least one cleaning roller is provided, which comprises cleaning elements that can be arranged in the a circumferential direction which that can run between the rows of elevations on the embossing patterns of punches or matrixes. Cleaning elements can be knife-like cleaning studs of such a



~~geometry to conform to a geometry of an embossing pattern of the~~ A punch or the  
~~matrix. Conveniently, both the punch and the matrix are each~~ a matrix can be fitted  
~~with a cleaning roller which is~~ that can be located outside ~~the~~ a path of ~~the~~ a web-  
shaped material to allow interaction with either the punch or the matrix. During  
operation ~~the~~ a cleaning elements continuously run in a circumferential direction  
~~between the elevations on each embossing pattern collecting~~ cleaning out sediment  
such as paper fibers and dust.

**[0022]** ~~Advantageously, the~~ Because cleaning elements run in ~~the~~ a circumferential direction  
of a cleaning roller, the cleaning roller ~~so it is~~ itself is cleaned. ~~The~~ e Cleaning  
elements ~~could~~ can also be radially offset in ~~the~~ an axial direction of ~~the~~ a cleaning  
roller to guarantee smooth and ~~non-plucking~~ operation of ~~the~~ a cleaning  
roller. ~~Conveniently, the~~ by preventing cleaning elements ~~are~~ of knife-like ~~a~~ cleaning  
studs ~~the geometry of which conforms to the geometry~~ roller from colliding with  
elevations of the embossing pattern ~~a punch or a matrix~~.

**[0023]**

**[0024]** ~~Finally, the elevations on the embossing pattern could also be arranged in a~~  
~~checker board pattern whereby the shape of each elevation is of lesser importance. Seen from a~~  
~~top view, the elevations could, for example, be cross shaped, square, oval or a similar shape, as~~  
~~long as the desired micro fissure embossing is achieved as the punch and matrix interact.~~

**[0025]**

~~Below, the invention is described in greater detail in the enclosed figures. They~~  
~~show:~~

**[0026]** ~~Figure 1-A is a schematic representation of a~~ diagram showing an exemplary punch 10  
~~in accordance with a first embodiment of the present invention;~~ Punch 10 is fitted

with an embossing pattern that includes elevations 16 arranged in rows 12 and 14 in a circumferential direction, which can be identical and cross shaped, when seen from above, whereby elevations 16 also are arranged in a checker board pattern.

- Figure 2 a schematic representation of a cleaning roller that interacts with the punch in figure 1;
- Figure 3 a schematic representation of a punch in accordance with a second embodiment of the present invention;
- Figure 4 a schematic representation of a cleaning roller that interacts with the punch in figure 3;
- Figure 5 an illustration of the path of the cleaning elements in figure 2 between the elevations on the punch in figure 1;
- Figure 6 an illustration of the path of the cleaning elements in figure 4 between the elevations on the punch in figure 3;
- Figure 7 a schematic representation of a punch in accordance with a third embodiment of the present invention;
- Figure 8 a schematic representation of a cleaning roller that interacts with the punch in figure 7; and
- Figure 9 a schematic representation of the interaction of the punch and cleaning roller in figures 7 and/or 8;

[0027] The punch 10, represented in figure 1, is fitted with an embossing pattern consisting of elevations 6 arranged in rows 12, 14 in circumferential direction which, when seen from above, are all identical and cross shaped whereby the elevations 16 also are arranged in a checker board pattern. The punch in figure 1 interacts with a  
Figure 2 is a schematic diagram showing an exemplary cleaning roller 20 from figure 2 on which several that can interact with punch 10 embodied in Figure 1. Several cleaning studselements 26, 26', and 28 are arranged in rows 22, 22 and 24 in a circumferential direction. Theon cleaning studs 26, roller 20. Cleaning elements 26 and 26' of each

row are spaced apart in a circumferential direction so that the cleaning function is briefly interrupted during operation, which prevents the cleaning studs 26, elements 26 and 26' from clogging as they pass very closely by the elevations 16. During the interruption, collected paper fibers can be removed from in between the cleaning studs 26, elements 26 and 26' by and the cleaning roller 20. The cleaning studs 26, Cleaning elements 26 and 28 are radially spaced apart in the an axial direction of the a embossing cleaning roller 20 in such a way that they, as a group of cleaning studs, elements 26 and 28 successively run between the spaced apart rows of elevations 16, preventing plucking collisions between cleaning elements of the cleaning roller 20 in the and elevations of punch 10. The angular arrangement of the cleaning studs 26, Cleaning elements 26 and 28 is encountered are radially offset in such a way that only one cleaning stud element 16 at any one time runs on an axial line of the a cleaning roller 20.

[0028] Figure 3 shows is a schematic representation of a variation of a diagram showing an exemplary punch 30 also in accordance with a second embodiment of the present invention. Punch 30 can be fitted with elevations 36 arranged in rows 32, 32 and 34 in a checker board pattern, however, where the distance between them the rows of elevations 32 and 34 is greater than the distance between the rows of elevations 12 and 14 in the another embodiment of the present invention shown in Figure 1. Correspondingly, the cleaning roller 40 shown in figure 4 is fitted with wider cleaning studs 44, 46', 48 so that the paper fibers and dust between the rows 32, 34 is completely gathered.

[0029] Figure 4 is a schematic diagram showing an exemplary cleaning roller 40 that can interact with punch 30 embodied in Figure 3. Cleaning roller 40 is fitted with wider cleaning elements 46, 46', and 48 than cleaning elements 26, 26', and 28, shown in Figure 2, such that paper fibers and dust collected between rows of elevations 32 and 34 are gathered.

[0030] Figure 5 shows the is a schematic diagram showing an exemplary path A of cleaning elements 26, 26', and 28 on cleaning roller 2020, embodied in Figure 2, between the elevations 16 on the embossing pattern of the punch 10 from figure embodied in Figure 1. By geometrically complementing the shapes of the elevations and the 16 with dimensions of the cleaning studs it is ensured that all elements 26, 26', and 28, fibers and all dust are can be removed from the surfaces of the embossing rollers to facilitate superior embossing roller facilitating a good embossing results. The interaction between the punch 30 shown in figure 3 and the Similarly, Figure 6 is a schematic diagram showing an exemplary path B of the cleaning elements 46, 46', and 48 on cleaning roller 40 shown in figure 4 is depicted embodied in figure 6. Figure 4, between elevations 36 on punch 30 embodied in Figure 3.

[0031] Figure 7 shows is a schematic diagram showing an exemplary punch in accordance with a third embodiment of a punch with the present invention. Figure 7 shows a pattern of regularly spaced-apart basically and substantially rectangular elevations 50 whose circumferential contour is slightly convex. A pattern for Figure 8 is a possible matchingschematic diagram showing an exemplary cleaning roller is shown that can interact with a punch such as that embodied in figure 8. The cleaning Figure 7.

Cleaning studs 52 that can run in a circumferential direction are can be fitted with horizontally running stud element segments 54 that correspond with the spaced-apart elevations 50 of the punch 50, as shown in Figure 7, of a punch, whereby axially neighboring stud element segments 54 are separated by a free space 56. The interaction Figure 9 is a schematic diagram showing an exemplary path of the punch in accordance with figure 7 and the cleaning roller cleaning elements embodied in accordance with figure 8 is shown Figure 8 between elevations on a punch embodied in Figure 9. 7.

**[0032]**

The characteristics of the invention revealed in the

**[0033]** Although Figures 1-7 illustrate the present invention as applied to a punch, one of ordinary skill in the art would readily appreciate that the cleaning roller of the present invention could be applied in a similar manner to a matrix. Indeed, as stated above- description, in the drawings, as well as, cleaning elements can cooperate with either punches or matrixes, or both.

**[0034]** The foregoing disclosure of the preferred embodiments of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many variations and modifications of the embodiments described herein will be apparent to one of ordinary skill in the patent art in light of the above disclosure. The scope of the invention is to be defined only by the claims could be significant for the realization of the invention individually as well as in any combination.

Patent claims appended hereto, and by their equivalents.

**WHAT IS CLAIMED IS:**

1. ~~Roller~~A roller arrangement for embossing a web-shaped materials, ~~in particular, web-~~  
~~shaped paper and tissue materials, with~~ comprising:

- ~~a punch, on which a first embossing pattern encompassing a plurality of spaced-~~  
~~apart elevations is arranged, and~~
- ~~a matrix on which a second~~

at least one embossing roller defining an embossing pattern encompassing  
wherein the embossing pattern comprises a plurality of spaced elevations aligned  
in rows that are spaced apart in a circumferential direction; and  
a cleaning roller defining a plurality of cleaning elements that are aligned between  
the rows of the at least one embossing roller.

2. The roller arrangement of claim 1, wherein the at least one embossing roller comprises a  
punch.

3. The roller arrangement of claim 1, wherein the at least one embossing roller comprises a  
matrix.

4. A roller arrangement for embossing a web-shaped material, comprising:  
a punch defining a first embossing pattern, wherein the first embossing pattern  
comprises a first plurality of elevations aligned in rows that are spaced apart  
elevations is arranged; in a circumferential direction;  
a matrix defining a second embossing pattern, wherein the second embossing  
pattern comprises a second plurality of elevations aligned in rows that are spaced  
apart in a circumferential direction; and  
a cleaning roller defining a plurality of cleaning elements that are aligned between  
the rows of one of the punch and the matrix.



~~5. Whereby the~~The roller arrangement of claim 4, wherein the plurality of elevations of  
the first embossing pattern are ~~lowered into~~is configured to align with free spaces ~~on~~between the  
plurality of elevations of the second embossing pattern,

~~6. The roller arrangement of claim 4, wherein the cleaning elements are aligned in a~~  
circumferential direction of the cleaning roller.

~~7. e~~characterized by the fact that~~The roller arrangement of claim 4, wherein the cleaning~~  
elements interact with the elevations (16, 36) on the embossing pattern ~~one~~ of the punch (10, 30)  
~~or~~and the matrix are positioned in rows (12, 14; 32, 34) that are spaced apart in the  
circumferential direction while at least one cleaning roller (20, 40) is provided which is fitted  
with cleaning elements (26, 26', 28; 46, 46', 48) in the circumferential direction which run  
between the rows (12, 14 and/or 32, 34) of elevations ~~on~~of the embossing pattern ~~one~~ of the  
punch ~~or~~and the matrix to remove sediment.

~~8. 2-Roller~~The roller arrangement in accordance with~~of claim 1, characterized by~~4, wherein  
the cleaning elements (26, 26'; 46, 46') ~~which~~ are spaced apart in the circumferential direction of  
the cleaning roller (20; 40).

~~9. 3-Roller~~The roller arrangement in accordance with~~of claim 1, characterized by~~8, wherein  
the cleaning elements (26, 28; 46, 48) ~~which~~ are radially offset in the axial direction of the  
cleaning roller (20; 40).

~~4. Roller arrangement in accordance with claim 1, characterized by the cleaning~~  
~~elements being knife-like cleaning studs.~~

~~10. 5. Roller~~ The roller arrangement in accordance with claim 1, characterized by ~~4. wherein~~  
the plurality of elevations in of at least one of the first and second embossing pattern which  
are patterns of the punch and matrix is arranged in a checker board pattern.

Abstract

11. The roller arrangement of claim 4, wherein the web-shaped material is tissue material.
12. The roller arrangement of claim 4, wherein the web-shaped material is paper.
13. The roller arrangement of claim 4, wherein one of the first embossing pattern and the second embossing pattern is cross-shaped.
14. The roller arrangement of claim 4, wherein one of the first embossing pattern and the second embossing pattern is square-shaped.
15. The roller arrangement of claim 4, wherein one of the first embossing pattern and the second embossing pattern is oval-shaped.
16. A method for embossing web-shaped material comprising:
  - rolling the web-shaped material over an embossing roller, the embossing roller defining a plurality of elevations in rows that are spaced apart in a circumferential direction;
  - positioning a cleaning roller adjacent to the embossing roller, the cleaning roller defining a plurality of cleaning elements that are aligned between the rows of the embossing roller; and
  - running the plurality of cleaning elements in between the rows of the embossing roller to remove sediment.

17. The method of claim 16, further comprising running the plurality of cleaning elements intermittently in between the rows of the embossing roller to remove sediment.

18. The method of claim 16, further comprising arranging the plurality of cleaning elements radially offset on the cleaning roller such that only one cleaning element at any one time runs between the rows of the embossing roller.

19. The method of claim 16, further comprising running the plurality of cleaning elements successively between the rows of the embossing roller.

20. The method of claim 16, wherein the embossing roller comprises one of a punch and a matrix.

## ABSTRACT OF THE DISCLOSURE

~~Roller~~A roller arrangement for embossing web-shaped materials, in particular, web-shaped paper and tissue materials, is disclosed. Said ~~A~~ roller arrangement comprises a punch ~~on~~, which includes a first embossing pattern, ~~encompassing~~containing a plurality of spaced-apart elevations ~~is arranged~~, and a matrix ~~on~~ which includes a second embossing pattern, ~~encompassing~~containing a plurality of spaced-apart elevations, ~~is arranged~~. The elevations on the first embossing pattern can be lowered into free spaces ~~on~~in between elevations of the second embossing pattern. ~~The inventive roller arrangement is characterized by the fact that the elevations on the embossing pattern of the punch or the matrix~~ Elevations on embossing patterns on punches and matrixes are positioned in rows that are spaced apart in the a circumferential direction ~~while at~~. At least one cleaning roller is provided, which comprises cleaning elements arranged in the a circumferential direction that ~~run~~interact with a punch or a matrix in between the rows of elevations on ~~the embossing pattern of the punch or the matrix~~patterns of punches and matrixes.